

Effect of moisture regimes and fertility levels on growth, yield and water use of French bean (*Phaseolus vulgaris*)

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ABSTRACT

A field experiment conducted during the winter seasons of 1994-95 and 1995-96 at Lakhaoti revealed that scheduling irrigation at IW : CPE ratio of 0.75 (4 irrigations each of 50 mm depth) and fertilizer application at 120 kg N + 90 kg P_2O_5 + 45 kg K_2O /ha resulted in higher grain yield of French bean (*Phaseolus vulgaris* L.). However, the effect of this dose of fertilizer was significantly superior over 80 kg N + 60 kg P_2O_5 + 30 kg K_2O /ha only in 1995-96. Both irrigation and fertilizer improved the growth and yield parameters markedly. Water use efficiency was highest at 0.25 IW : CPE ratio. Consumptive use of water was higher at 1.00 IW : CPE ratio and fertilizer application at 120 kg N + 90 kg P_2O_5 + 45 kg K_2O /ha.

Key words: French bean, Moisture regimes, Fertility levels

French bean (*Phaseolus vulgaris* L.) is highly protein rich grain legume of north India. Though, the crop has a higher yield potential, its average yield is very low especially in western Uttar Pradesh. There is a meagre information on its need for fertilizer and water. It is therefore imperative to find out its optimum fertilizer and water requirement to realize its maximum yield potential (Ali and Kushwaha, 1987). In the light of above, the present investigation was carried out to evaluate the response of French bean to irrigation and applied fertilizers.

MATERIALS AND METHODS

The field experiment was conducted at Amar Singh College, Lakhaoti, (U.P.) during winter seasons of 1994-95 and 1995-

96. The experiment was laid out in a split plot design having 4 moisture regimes (50 mm irrigation at 0.25, 0.50, 0.75 and 1.00 IW/CPE ratios) as main plot treatments and 4 levels of fertility (no fertilizer, 40 + 30 + 15, 80 + 60 + 30 and 120 + 90 + 45 kg of N + P_2O_5 + K_2O /ha) as sub-plot treatments replicated thrice. The soil was sandy loam with pH 7.5, and low in organic carbon (0.45%), and medium in available P and K. The field capacity and permanent wilting point values were 17.30 and 4.25%, respectively. The variety 'PDR 14' was sown with 30 × 15 cm spacing. The entire quantity of P and K, and half quantity of N as per treatment were applied at sowing as basal dose and remaining half N was top-dressed 25 day after sowing.

RESULTS AND DISCUSSION

Moisture regime

Application of irrigation water at 1.0 IW : CPE ratio being on par with 0.75 IW : CPE ratio recorded taller plants and dry

matter/plant than irrigation at 0.25 and 0.50 IW : CPE ratios. The differences between the latter two were also marked where irrigation at 0.50 IW : CPE ratio recorded more plant height and dry matter than 0.25

Table 1. Effect of moisture regime and fertility levels on growth parameters and grain yield of french bean

Treatment	Plant height (cm)		Branches/plant		Dry matter/plant (g)		Grain yield (q/ha)	
	1994-95	1995-96	1994-95	1995-96	1994-95	1995-96	1994-95	1995-96
<i>Moisture regime (IW : CPE ratio)</i>								
0.25	38.9	35.2	7.6	7.8	24.4	23.4	11.4	11.7
0.50	40.3	36.3	8.4	7.9	28.4	26.8	12.5	13.5
0.75	40.8	37.1	8.8	8.4	35.7	32.2	14.7	15.9
1.00	41.5	37.9	10.3	8.9	35.9	32.5	14.6	15.8
CD (P = 0.05)	0.88	1.08	0.59	NS	3.88	1.32	1.02	0.71
<i>Fertilizer (N : P₂O₅ : K₂O, kg/ha)</i>								
0 : 0 : 0	29.8	26.8	6.8	6.8	17.7	17.1	8.2	7.9
40 : 30 : 15	42.7	34.2	8.3	7.4	25.3	24.2	10.4	11.6
80 : 60 : 30	43.4	40.8	9.5	9.2	38.4	34.3	16.7	17.9
120 : 90 : 45	45.6	44.6	10.3	9.9	42.8	39.2	17.8	19.6
CD (P = 0.05)	0.91	1.55	0.30	1.04	1.91	2.91	1.36	1.58

Table 2. Effect of moisture regimes and fertility levels on consumptive use of water and water use efficiency in french bean

Treatment	Consumptive use of water (mm)		Water use efficiency (kg/mm/ha)	
	1994-95	1995-96	1994-95	1995-96
<i>Moisture regime (IW : CPE ratio)</i>				
0.25	144.60	168.24	7.74	6.89
0.50	182.67	206.56	6.75	6.47
0.75	244.44	285.62	5.83	5.47
1.00	300.12	319.35	4.84	4.92
<i>Fertilizer (N : P₂O₅ : K₂O, kg/ha)</i>				
0 : 0 : 0	207.36	234.24	3.80	3.20
40 : 30 : 15	215.05	242.00	4.80	4.70
80 : 60 : 30	222.63	250.01	7.90	7.40
120 : 90 : 45	226.79	253.53	8.50	8.20

IW : CPE ratio (Table 1). Irrigation at 1.0 IW : CPE ratio in 1994-95 recorded the highest number of branches/plant. In 1995-96, branches/plant were not significantly affected due to various moisture regimes. In both the years, grain yield increased significantly when irrigation was applied at IW : CPE ratio of 0.75 and 1.00 compared to IW : CPE ratio of 0.25 and 0.50. Irrigation at 0.50 IW : CPE ratio produced higher yield than irrigation at 0.25 IW : CPE ratio.

The consumptive water use increased with increasing IW : CPE ratios, being the maximum (300.12 and 319.35 mm in 1994-95 and 1995-96, respectively) at 1.00 IW : CPE ratio. The increase in consumptive use of water with increasing IW : CPE ratios could be attributed to increasing number of irrigation. The water use efficiency, however, decreased with liberal irrigation or irrigation at higher IW : CPE ratio. This could be ascribed to the fact that the increase in yield was not proportionate to the increase in consumptive water use. These findings are in agreement with those reported by Ahlawat and Sharma (1989).

Fertilizer

With increasing fertility, growth and yield parameters, and grain yield increased significantly in both the seasons. However,

the differences between 80 + 60 + 30 and 120 + 90 + 45 kg N + P₂O₅ + K₂O/ha were not marked in branches/plant in 1995-96 and in grain yield in 1994-95. Similar findings were also reported by Kushwaha *et al.* (1985).

Though consumptive water use showed a tendency to increase with increasing fertility levels, the magnitude of increase was small. On the other hand, magnitude of increase in yield with increasing fertility levels was higher thereby resulting in higher water use efficiency. The water use efficiency was more than double with 120 + 90 + 45 kg N + P₂O₅ + K₂O/ha as compared to no fertilizer. The marked increase in water use efficiency may be attributed to favourable effects of fertilizer nutrients on crop yield.

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